Impact of Inflation, Exchange Rates, and Interest Rates on Public Debt: An Econometric Analysis of Developing Countries

Nouhaila Belfatmi* and Hicham Ouakil

Laboratory of Economic and Public Political Sciences, Université Ibn-Tofail

Abstract: The objective of this article is to analyze the impact of exchange rates, inflation, and interest rates on public debt in developing countries, with particular focus on Morocco. This analysis incorporates a range of macroeconomic control variables to provide a more comprehensive understanding of the underlying dynamics. To achieve this, the panel data econometric method, specifically the System GMM approach developed by Blundell and Bond (1998), has been employed. This method is particularly suited to address issues of endogeneity and simultaneity bias commonly encountered in macroeconomic studies.

To analyze the impact of monetary variables on public debt, the panel data method was applied to a sample of 47 developing countries, covering the period from 1990 to 2022.

Keywords: Public Debt, Monetary Variables, Panel Data, System GMM.

1. INTRODUCTION

In an increasingly globalized world, the issue of household debt has become multidimensional, influenced by the macroeconomic policies pursued by countries in the context of globalization. Understanding the interdependencies between variables such as interest rates, inflation, exchange rates, and public debt is essential for designing an appropriate and stable macroeconomic policy. In this regard, many countries have implemented various fiscal, monetary, and exchange rate policies aligned with their economic objectives over the past few decades.

Interest rates, inflation, exchange rates, and public debt are dynamic macroeconomic variables, particularly crucial for developing economies. Africa, which accounts for 18% of the world's population but less than 3% of global GDP in 2023, is a prime example of this dynamic. Few previous studies have examined the interrelationships between these variables and their impacts on public debt within the context of fragile African economies. The response of interest rates, inflation, and exchange rates to debt is often more pronounced in these countries, rendering them more vulnerable to sudden domestic and international shocks.

These vulnerabilities are partly due to the economic and political structures of African countries and their degree of integration with the global economy. Moreover, several of these countries have recently adopted innovative macroeconomic strategies compatible with floating exchange rate regimes, such as inflation targeting. The volatility of exchange rates and the variability of interest rates further highlight the importance of this issue. Recent geopolitical disruptions, such as the war in Ukraine and the aftermath of the pandemic, have also prompted countries to reassess the coherence of their macroeconomic policy tools in order to ensure financial stability.

This article empirically examines the impact of interest rates, inflation, and exchange rates on public debt using data from African countries. It seeks to determine whether there are long-term dynamic impacts of these variables within the countries of the sample, explore the empirical relationships between them, and justify these interrelationships. Finally, the article discusses the policy implications for these countries, proposing strategies to better manage public debt and promote sustainable macroeconomic stability.

2. LITERATURE REVIEW

2.1. Theoretical Framework

2.1.1. The Relationship between Interest Rates, Inflation, and Exchange Rates in Theory

The relationship between interest rates, inflation, and exchange rates is fundamental in macroeconomics. Central banks influence interest rates through monetary policy, which, in turn, affects exchange rates and inflation via the monetary transmission mechanism. For example, an increase in domestic interest rates, in an economy with perfect capital mobility, attracts foreign capital, leading to an appreciation of the national currency and a rise in exchange rates. However, if domestic inflation rates differ from those abroad, this effect may be moderated. Theoretically, an increase in interest rates is expected to influence inflation.

2.2. The Fisher Hypothesis

Irving Fisher proposed a long-term direct relationship between nominal interest rates and expected inflation:

*Address correspondence to this author at the Laboratory of Economic and Public Political Sciences, Université Ibn-Tofail;
E-mail: belfatminouhaila@gmail.com

$$i_t = r_t + \pi_t$$

where i_t is the nominal interest rate, r_t is the real interest rate, and π_t is expected inflation. This equation suggests that nominal interest rates increase with expected inflation, while real interest rates remain stable. Real interest rates are determined by macroeconomic fundamentals such as capital productivity and investors' time preferences, rather than monetary shocks.

2.3. Factors Influencing Real Interest Rates and Expected Inflation

Real interest rates and expected inflation are influenced by various factors. Real interest rates are primarily determined by the demand and supply of available funds in an economy. Expected inflation is affected by temporary factors (such as changes in food and energy prices) and permanent factors (such as government policies and geopolitical issues).

2.4. Monetary Transmission Mechanisms

Interest rates influence inflation and exchange rates through several mechanisms. A reduction in interest rates lowers the cost of borrowing, encouraging consumers to spend more, which stimulates aggregate demand and creates inflationary pressure. Lower interest rates also encourage businesses to invest more. In contrast, higher interest rates reduce consumption and investment, alleviating inflation. Regarding exchange rates, higher domestic interest rates attract foreign capital, leading to an appreciation of the national currency.

2.5. The Link Between Interest Rates and Exchange Rates

The relationship between interest rates and exchange rates is often explained by the interest rate differential between countries, which influences international capital flows. Frankel (1979) proposed two approaches: the international goods market approach and the asset market approach. According to the Chicago view, higher interest rates signal higher expected inflation, which depreciates the domestic currency. The Keynesian view, however, suggests that higher interest rates attract foreign capital, appreciating the domestic currency in the absence of expected inflation. Dornbusch (1976) also demonstrated that interest rates can negatively influence exchange rates in the short run.

2.6. The Link Between Exchange Rates and Inflation

According to Barro and Gordon (1983), a fixed exchange rate regime can help reduce inflation by strengthening the credibility of monetary policy. A floating exchange rate regime, on the other hand, automatically corrects external imbalances through exchange rate variability, which can lead to higher inflation. However, a flexible exchange rate regime offers monetary independence, allowing governments to pursue policies that favor economic growth. In an open economy, exchange rate fluctuations influence the prices of imported goods, affecting domestic inflation. Inflation expectations can also lead to exchange rate volatility, highlighting the complex interrelationship between exchange rates and inflation.

3. EMPIRICAL STUDIES

Fama (1975) and Mishkin (1992) conducted studies on the relationship between interest rates and inflation in the United States, yielding contrasting results. Fama (1975) found a strong positive short-term relationship between interest rates and inflation, particularly in the Treasury bond market, and emphasized the importance of past interest rates and inflation in determining current inflation. In contrast, Mishkin (1992) found no evidence of a short-term Fisher effect, but supported the existence of this effect in the long term, confirming a positive relationship between interest rates and expected inflation.

Other studies have focused on developing countries and the links between interest rates, inflation, and exchange rates. Tsong and Hachicha (2014) confirmed the long-term Fisher effect for four developing countries, although economic shocks could affect this relationship. Goldfajn and Baig (2002) showed a weak correlation between real interest rates and real exchange rates in Asia, while Chen (2006) indicated that high interest rates increase the risk of a currency crisis. Finally, Choudhri and Hakura (2006) revealed that the exchange rate pass-through to domestic prices is more pronounced in high-inflation countries, suggesting that the higher the inflation, the more significant this effect is.

Arslaner *et al.* (2014) demonstrated that exchange rate pass-through influences domestic inflation in Turkey, with a more pronounced impact on the producer price index than on the consumer price index. They also emphasized the importance of past currency crises and trade openness in this phenomenon. Bildirici and Ersin (2007) suggested that an increase in domestic debt and a reduction in debt maturities leads to an inevitable inflationary process, amplified by strict interest rate policies that increase interest payments and the stock of domestic debt, pushing emerging economies toward inflationary spirals. Ahmad et al. (2012) corroborated these findings for Pakistan, asserting that domestic debt and its servicing cost contribute to price fluctuations. Meanwhile, Karakaplan (2009) revealed that external debt exerts a lower inflationary effect in financially developed economies, with varied relationships among 121 countries studied from 1960 to 2004.

Ogege and Ekpudu (2010) employed ordinary least squares (OLS) to examine the impact of debt burden on economic growth in Nigeria, revealing a negative impact of debt stock on growth. Fagbola et al. (2020), using an autoregressive distributed lag (ARDL) model for data from 1981 to 2018, confirmed that external debt has slowed Nigeria's economic growth. Aderemi et al. (2020) studied exchange rate volatility and the trade balance in Nigeria, concluding that exchange rate volatility had a detrimental effect on the trade balance. Ijeoma (2013) found a significant relationship between external debt service and gross fixed capital formation, as well as the impact of exchange rate fluctuations on external debt and economic growth. Siok, Cheau, and Mohd (2012) found a significant correlation between exchange rate movements and inflation in some Asian countries. Blessy and Lakshmi (2020) employed the ARDL model to show that the depreciation of the Indian rupee increases the external debt burden, highlighting the impact of ex-

change rate fluctuations on external debt sustainability and the resulting financial challenges.

Research by Devereux et al. (2006) highlighted the increase in external debt in emerging economies following currency depreciation, revealing a close link between exchange rate fluctuations and external debt levels. Bunescu (2014) examined this relationship in Romania using the Fisher-Snedecor F-test, demonstrating that external debt significantly influences exchange rate variations. This dynamic underscores the importance for emerging economies to carefully monitor their external debt and exchange rate movements to maintain economic stability.

Alam and Taib (2013) extended the analysis by studying the relationship between external debt, fiscal deficits, current account deficits, and currency depreciation in developing Pacific Asian countries, distinguishing between Debt Trap Countries (DTC) and Non-Debt Trap Countries (NDTC). Their study confirmed a positive relationship between these variables, although the strength of this relationship varied between DTC and NDTC. Simultaneously, Sene (2004) extended the Obstfeld and Rogoff model to examine the correlation between external public debt and the equilibrium real exchange rate.

Patrawimolporn (2007) used a simple differentiation technique to analyze how exchange rate fluctuations influence public debt, debt service, and debt management in Thailand, emphasizing the direct impact of exchange rate fluctuations on these crucial elements of financial stability. Reinhart and Rogoff (2010) showed that high levels of public debt, particularly with a debt-to-GDP ratio above 90%, have a negative effect on economic growth, with average growth rates being nearly 4% lower in advanced countries. Panizza and Presbitero (2013) reviewed the literature on the relationship between public debt and economic growth, concluding that this relationship varies significantly between countries and over time, adding complexity to public debt management.

The relationship between public debt and economic growth is complex and heterogeneous, varying according to the specifics of each economy. This variability can be attributed to factors such as the structure of the debt (level, domestic/foreign composition, interest rates), fiscal and budgetary policies, the level of economic development, and external economic shocks. Understanding this heterogeneity is crucial for policymakers and economists, who must adopt flexible approaches tailored to the particularities of each economy to manage public debt and promote sustainable growth.

Numerous studies confirm a non-linear negative relationship between public debt and economic growth. Kumar and Woo (2010) show that public debt levels exceeding 90% of GDP significantly slow growth. Cecchetti et al. (2011) identify a similar threshold of 85% of GDP. Checherita-Westphal and Rother (2012) find a turning point around 90-100% of GDP. Baum et al. (2013) indicate that in the short run, debt has a positive impact up to a 67% ratio, beyond which it becomes negative. Afonso and Jalles (2013) establish thresholds of 58% of GDP for the eurozone and 79% for emerging countries, further emphasizing the diversity of debt impacts on growth depending on economic contexts.

Some studies suggest that the negative relationships between public debt and economic growth depend heavily on the specific context of the countries and periods studied. Kourtellos et al. (2013) find that the negative impact of public debt on growth is present only in low-democracy countries. Dreger and Reimers (2013) show that this negative impact is limited to the eurozone and periods of unsustainable debt, diminishing in industrialized countries where sustainable debt can even foster growth. Égert (2015) highlights that results vary across periods and countries, with negative effects detected at much lower levels of public debt. Eberhardt and Presbitero (2015) find a long-term negative relationship between public debt and growth across countries, but no debt threshold within countries. Panizza and Presbitero (2014) note that once endogeneity is corrected, the negative link disappears, especially when considering valuation effects induced by debt in foreign currencies and exchange rate movements.

The relationship between public debt, economic growth, and long-term interest rates is complex and requires an analysis of the channels through which debt affects growth. Reinhart et al. (2012) and Baldacci and Kumar (2010) argue that high levels of public debt increase risk premiums and long-term interest rates, thus reducing growth by diminishing interest-sensitive investments. However, some studies, such as those by Checherita-Westphal and Rother (2012), find no statistically significant link between the debt-to-GDP ratio and long-term interest rates. Using a panel VAR model, Lof and Malinen (2014) and Puente-Ajovín and Sanso-Navarro (2015) examine the dynamic interactions between public debt, economic growth, and interest rates. They conclude that the negative correlation between debt and growth is primarily due to the impact of growth on debt, rather than the reverse, indicating that economic growth influences public debt more than it is influenced by it.

The origins of public debt accumulation lie in the necessity for governments to cover their deficits, forcing them to borrow the necessary amounts from third parties. Moreover, nearly all studies (e.g., Sinha et al., 2011; Pîrtea et al., 2013; Gargouri and Ksantini, 2016) agree that the current level of a country's public debt depends on its previous level and the magnitude of the current fiscal deficit. However, it is worth noting that, while part of the current fiscal deficit may be determined by government spending to repay past loans and associated interest payments, another part of the deficit is primarily generated by the macroeconomic conditions characterizing the country.

The relationship between public debt and economic growth has been extensively addressed in the literature, with numerous authors identifying bidirectional dependencies between these two indicators. However, while economic growth can lead to higher incomes within an economy, this should result in higher tax revenues for the government and, consequently, a reduction in the budget deficit or even a surplus, ultimately determining either a reduction in public debt or, at the very least, a slowdown in its growth, but almost certainly a decrease in the debt-to-GDP ratio. In this regard, it is not surprising that Hall and Sargent (2010) found that

between 1946 and 1974, economic growth in the United States led to a reduction in the debt-to-GDP ratio. Furthermore, in analyzing a group of South American countries, Bittencourt (2015) reached the same conclusion regarding the negative impact of GDP growth on public debt. Similarly, Krugman (1988), Claessens (1990), and Globan and Matosec (2016) demonstrated a negative correlation between economic growth and public debt, with GDP growth rate emerging as one of the most significant factors influencing public debt. Inflation is another macroeconomic determinant of the magnitude of public debt considered by most existing studies. While inflation erodes the value of money, it also diminishes the value of debt, including public debt. This concept has also been confirmed by the results of Aizenman and Marion (2009), Hall and Sargent (2010), Swamy (2015), and Bittencourt (2015), who found a negative influence of inflation on public debt.

Foreign direct investment (FDI) plays a crucial role in reducing public debt by alleviating the financial pressure on governments to fund economic development. This is due to the influx of external financial support through the attraction of foreign investors, thus reducing the need for government borrowing. However, the impact of capital formation on public debt varies depending on the source of funding: if the private sector takes on the responsibility, the effect is similar to that of FDI, reducing public debt, but if the government finances the capital, debt increases. Theories such as those of Sargent and Wallace (1981) and the fiscal theory of the price level explain how the management of public debt can lead to inflation, which has historically contributed to reducing debt after World War II. Despite calls for higher inflation to reduce debt, inflation remains low in many advanced economies. "Financial repression" is also used to manage public debt by keeping interest rates low despite high inflation, but its effectiveness varies depending on economic contexts. Studies suggest that inflation alone is unlikely to resolve the fiscal burden of advanced economies, underscoring the complexity of public debt management in a dynamic economic environment.

Empirical literature on the effects of inflationary shocks on public debt shows varied and sometimes contradictory results. While some studies, such as those by J.P.B. Romero and K.L. Marin (2017), suggest that further increases in public debt may be inflationary in countries where debt is already high, other studies, such as that by C.A. Sims (2014), highlight that the effect of rising debt on inflation depends on how the government manages this debt, particularly if it resorts to money printing to finance its obligations. For example, persistent and growing borrowing may lead to an increase in the money supply and, consequently, higher prices, i.e., inflation.

Research such as that of Afonso and Y. Ibraimo (2018) on Mozambique explores the macroeconomic impacts of public debt by distinguishing between external and domestic debt and the debt service on inflation. They reveal variable effects, indicating that domestic debt can temporarily stimulate prices, while debt servicing and other factors also have an impact. Similarly, the works of I. Bilan and A. Roman (2014) analyze the effect of public borrowing on inflation, taking into account different types of borrowing and their impact on the money supply, highlighting the complexity of this relationship, which includes debt monetization and wealth effects. Additionally, country-specific studies such as those by S.N. Essien, N.T.I. Agboegbulem, M.K. Mba, and O.G. Onumonu (2016) in Nigeria or A. Nastansky and H.G. Strohe (2015) in Germany underscore the differences in the effects of public debt on inflation depending on the unique economic and monetary characteristics of each country.

Finally, it is important to note that despite the diversity of approaches and findings in the literature, no clear consensus has been reached regarding the effect of public debt on inflation. Results vary depending on the methodologies used, the country samples analyzed, and the periods studied, thus underscoring the necessity for in-depth analysis that accounts for the specificities of each economic context.

4. METHODOLOGY, DATA, AND ECONOMETRIC ESTIMATION

After defining the theoretical and empirical framework presented in the literature review, we will introduce and justify our analytical tools. This will involve explaining the methodological approach, proceeding with model specifications and econometric estimations, and interpreting the obtained results.

4.1. Methodology

The methodological approach will first consist of specifying the model, defining and justifying the variables included in the study, and then clarifying the analytical instrument related to the impact of inflation, exchange rates, and interest rates on public debt within the context of the considered panel.

4.2. Model Specification

This study aims to examine the relationship between inflation, exchange rates, interest rates, and public debt using the basic model of Ojo (1989), with the debt-to-GDP ratio (β) as the dependent variable. The explanatory variables include the variation in exports, imports relative to GDP, population, and the GDP growth rate. This baseline model will be adjusted to address our specific research question and the particular economic environment of our panel, in order to develop an adapted empirical model.

Our approach draws inspiration from the works of Akitoby[1], B., Binder, A., & Komatsuzaki, T. (2017), Gomez-Gonzalez[2], P. (2019), Cahyadin, M., & Ratwianingsih, L. (2020), and Della Posta, P. (2019). These authors use estimators that combine both panel data and time series econometrics through dynamic and static estimations, confirming the robustness of their results by using alternative estimators. In our study, we formulate the following dynamic model:

1 Akitoby, B., Binder, A., & Komatsuzaki, T. (2017). Inflation and public debt reversals in the G7 countries. Journal of Banking and Financial Economics, (1 (7), 28-50.

2 Gomez-Gonzalez, P. (2019). Inflation-linked public debt in emerging economies. Journal of International Money and Finance, 93, 313-334.

$$Debt/GDP_{it} = \beta_0 + \beta_1 (Inflation - Exchangerate - Interestrate)_{it} + \beta_2 \sum_{i=2}^{k} (controls)_{it} + \varepsilon_{it}$$

Where:

- **Debt/GDP**: The public debt ratio (public debt / GDP)
- **Interest**: The real interest rate (%)
- **ExchRate**: The real effective exchange rate index (2010 = 100)
- **Inflation**: Inflation in the economy, calculated using the consumer price index
- **Deficit**: The budget deficit / GDP ratio
- **FBCF**: Gross fixed capital formation as a percentage of GDP
- **Openness**: Degree of openness / GDP
- **PopGrowth**: The population growth rate
- (i,t): The cross-sectional and time dimensions of the country panel
- ε_{it} **:**The error term

4.3. Description, Definition, and Characteristics of Variables

The model adopted to analyze the impact of inflation, exchange rates, and interest rates on public debt cannot be used without justifying the variables assigned to it. The selection of variables (or data) was guided by both the theoretical and empirical literature, as well as the availability and reliability of data. The study covers a panel of 47[3] developing countries.

The study's data period spans 33 years, from 1990 to 2022, a period that covers over three decades. This timeframe is chosen because it includes episodes during which fiscal and monetary policies experienced several budgetary imbalances. Another key reason for selecting this period is that it encompasses a set of policies aimed at improving the sustainability of public debt. Data sources include the World Bank (WDI) statistics and the IMF (WEO) statistics. The panel of developing countries was selected, ensuring that the primary data are not highly dispersed within the sample.

The countries in the sample are from Africa, Asia, Europe, and Central and South America. As shown in the table below, Sub-Saharan African countries account for 29% of the total sample, and it is noteworthy that most of the countries in our sample are members of the WTO.

Table 1. Distribution of the Sample Countries (in %).

Country	Geographical Region	Percentage (%)
Armenia, Kyrgyzstan, Moldova, Tajikistan, Ukraine	Europe & Central Asia	14%
Bangladesh, India, Pakistan	South Asia	9%
Bolivia, El Salvador, Guatemala, Honduras, Nicaragua	Latin America & the Caribbean	14%
Cambodia, Indonesia, Laos, Mongolia, Myanmar, Philippines, Sri Lanka, Vietnam	East Asia & Pacific	23%
Côte d'Ivoire, Ghana, Cameroon, Kenya, Republic of Congo, Lesotho, Mauritania, Sudan, Eswatini (formerly Swaziland), Zambia	Sub-Saharan Africa	29%
Egypt, Jordan, Morocco, Tunisia	MENA	11%

Source: Author's compilation

4.4. Presentation of the Econometric Method: SYS-GMM

The Generalized Method of Moments (GMM) methodology in dynamic panels, developed by Arellano and Bond (1991), and later improved by Arellano and Bover (1995) and Blundell and Bond (1998), is designed to address simultaneity and endogeneity biases in dynamic equation estimations. Unlike OLS, GMM allows for controlling individual and time-specific effects and correcting for endogeneity biases in the explanatory variables. The system GMM estimator (Sys-GMM) developed by Blundell and Bond (1998) is particularly suitable for short dynamic panels (small T) by combining first-difference equations and level equations to obtain more efficient estimates.

In GMM methodology, the instruments used must be valid, and the error terms should not exhibit autocorrelation. However, the first-differenced GMM estimator suffers from weak correlation between instruments and regressors, especially in small samples. To address this issue, the system GMM uses lagged values of the explanatory variables as instruments, thereby improving the efficiency of the estimation. The validity of the instruments can be tested using the Sargan/Hansen over-identification test, and the absence of autocorrelation in the error terms is verified by a second-order autocorrelation test. The two-step system GMM estimation is implemented in Stata via the xtabond2 command, providing asymptotically more efficient estimates.

4.5. Results from Dynamic Panel Using SYS-GMM

In this section, we analyze the impact of inflation, exchange rates, and interest rates on public debt using the two-step SYS-GMM methodology. Overall, the Sargan/Hansen tests and the AR2 tests confirm the validity of the instruments. Table (3) presents the results obtained from the estimation using the SYS-GMM method.

We estimate several specifications for the model outlined above. The results derived from the estimation using the

[3] The country sample consists of: Armenia, Bangladesh, Bolivia, Cambodia, Cameroon, Republic of Congo, Ivory Coast, Egypt, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Jordan, Kenya, Kyrgyz Republic, Lao People's Democratic Republic, Lesotho, Mauritania, Moldova, Mongolia, Morocco, Myanmar, Nicaragua, Pakistan, Philippines, Sri Lanka, Sudan, Eswatini (formerly Swaziland), Tajikistan, Tunisia, Ukraine, Vietnam, and Zambia.

SYS-GMM methodology on the dynamic panel largely align with the trend observed in the OLS and fixed effects estimations.

The Wald test for the joint significance of the explanatory variables is statistically significant at the 1% level for all models. The Hansen test does not allow us to reject the null hypothesis of the validity of the instruments used in the regression for both models.

Moreover, we observe that there is no second-order autocorrelation of the errors in the first-differenced equation (AR2), since the second-order autocorrelation test (AR2) by Arellano and Bond does not reject the null hypothesis of no first-order autocorrelation (AR1 = 0.001 for both specifications, AR2 = 0.640 for the simple specification and AR2 = 0.472 for the quadratic specification). The result of our growth model with the key variable, the budget deficit, is reliable as it passes all diagnostic tests.

The variables have different effects on economic growth, and the results suggest a more significant impact from government investment and spending.

Table 2. Inflation, Exchange Rate, Inflation, and Public Debt on Dynamic Panel: SYS-GMM Estimator (Blundell & Bond, 1998)

Dependent Variable: Debt/GDP	**SYS-GMM**
Constant	0.034 (0.005)**
Debt/GDP (-1)	0.001 (0.078)*
Interest	-0.045 (0.152)
Exchange Rate	0.010 (0.194)
Inflation	0.210 (0.101)
Budget Deficit	-0.001 (0.112)
Gross Fixed Capital Formation	-0.210 (0.000)***
Openness	-0.397 (0.000)***
Observations	1358
Wald Test	157.04 (0.000)***
AR(1)	0.001
AR(2)	0.640
Sargan/Hansen Test	0.910

Notes: Values in parentheses are p-values. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. The AR2 statistic represents the second-order autocorrelation test. The values in the table are p-values for the AR2 statistic, showing that there is no second-order autocorrelation. Although the AR1 statistic validates the hypothesis of first-order autocorrelation (AR1 = 0.001 for both specifications). The values in the table represent p-values from the Hansen test, which accept the null hypothesis of instrument validity (at the 5% level for both specifications).

From the above table, the results of the SYS-GMM estimation for the public debt equation show that:

For the public debt variable **Debt/GDP (-1)**, the effect is positive and significant. In fact, the positive and significant impact of the lagged debt variable on the current debt level can be explained through several economic and financial mechanisms. The positive and significant impact of the lagged public debt on current debt is well-documented in the economic literature, particularly for developing countries. Recent studies such as Afonso and Alves (2015), Reinhart and Rogoff (2010), Presbitero (2012), Panizza and Presbitero (2014), and Eyraud and Weber (2013) show that high levels of public debt tend to persist. Governments of these countries often issue new bonds to repay old ones, particularly during periods of budgetary constraints, leading to a continuous accumulation of debt. These studies highlight refinancing mechanisms as a major cause of this persistence, emphasizing that the need to refinance past debts directly influences current debt levels.

In developing countries, the impact of interest rates on public debt is often mitigated by various institutional, structural, and economic factors. Financial institutions play a crucial role in debt management. For example, a World Bank study (2021) shows that interventions by central banks to stabilize financial markets can reduce the impact of interest rates on public debt. Exchange rate policies and financial regulations also contribute to this attenuation. Additionally, developing countries have alternative financing sources such as international aid, concessional loans, and foreign direct investment (FDI), which are less sensitive to global interest rate fluctuations. Fowowe (2019) demonstrates that FDI is particularly crucial for financing development in Sub-Saharan Africa.

Certain economic strategies help moderate the impact of interest rates. Inflationary policies, by eroding the real value of debt, make repayment easier, as revealed by an IMF (2020) analysis of several Latin American countries. The specific structure of public debt, with a significant portion denominated in domestic currency or at fixed rates, makes it less sensitive to fluctuations in global interest rates. Eichengreen and Hausmann (2017) emphasize the importance of the "fear of floating," where countries prefer issuing debt in local currency to avoid exchange rate risks. Finally, investor perceptions of risks associated with developing countries also influence this dynamic. Borensztein and Panizza (2018) observed that risk premiums on sovereign bonds from developing countries can partially offset variations in interest rates, thus moderating their impact on public debt.

Exchange rate fluctuations have a significant negative impact on public debt in developing countries, primarily due to the increased cost of debt denominated in foreign currencies. When the local currency depreciates, repaying foreign-currency debt becomes more expensive, thus increasing the public debt burden. For instance, Eichengreen and Hausmann (2017) highlight that the "fear of floating" pushes countries to issue debt in local currencies to avoid these exchange risks, though this is not always possible or sufficient. Furthermore, exchange rate fluctuations can erode foreign exchange reserves as central banks must intervene to stabilize the currency, reducing the resources available to service the debt. This erosion of reserves can also lead to imported inflation, raising the cost of imported goods and services, further exacerbating economic tensions. Loss of investor confidence, often linked to significant exchange rate fluctuations, leads to higher risk premiums on new debt issuances, as observed by Borensztein and Panizza (2018). These combined dynamics make public debt management particularly difficult, amplifying economic and social tensions in developing economies.

The lack of a significant correlation between inflation and public debt in developing countries can be explained by several factors. First, according to Rogoff and Reinhart (2010), the composition of debt is crucial: debt denominated in local currency rather than foreign currencies mitigates the impact of inflation on debt levels. Similarly, fixed-rate borrowing, as noted by Blinder (2017), limits the effects of inflationary fluctuations. Regarding debt management, research such as Reinhart and Sbrancia (2015) shows that debt restructuring policies can better cope with inflation. International interventions, such as financial aid from the IMF or the World Bank, also play a key role in reducing inflation's impact on public debt, as demonstrated by empirical analyses of structural adjustment programs in developing countries (Bird et al., 2013). Thus, the complex relationship between inflation and public debt depends on the composition of the debt, debt management policies, and external interventions, all of which help alleviate inflationary pressures on public debt in developing countries.

The negative coefficient of the **Gross Fixed Capital Formation** variable reflects the complex effects of contractionary fiscal measures adopted by developing countries in response to the global financial crisis. The specificities of agreements with donors and the flexible use of international borrowing partly explain this anomaly compared to theoretical expectations.

The lack of a significant correlation between the budget deficit and the debt-to-GDP ratio in developing countries is indeed influenced by several factors, as highlighted by various empirical studies. For example, research by Aizenman and Jinjarak (2012) emphasizes the importance of diversifying funding sources to mitigate the direct impact of the budget deficit on debt levels. Interventions from international financial institutions, such as the IMF and the World Bank, have also been identified as key factors in managing debt in developing countries, as shown by Powell and Tavella (2019).

Moreover, debt management strategies play a crucial role in moderating debt levels despite budget deficits. A study by Reinhart and Rogoff (2009) highlights the impact of debt restructuring and refinancing policies on the debt dynamics of these countries. Additionally, economic cycles, monetary policies, and financial policies, as observed in the work of Mauro et al. (2019), also influence the relationship between budget deficits and public debt in developing economies.

Trade openness has a significant effect on public debt in developing countries. Empirical studies, such as Dollar (1992), have shown a negative relationship between trade openness and public debt, indicating that the more open a country is to trade, the less likely it is to accumulate public debt. This relationship can be explained through several mechanisms. First, trade openness increases foreign currency reserves, which enhances the ability of countries to meet their international financial obligations and reduces reliance on debt. Furthermore, trade openness stimulates economic growth by fostering the exchange of goods and services, contributing to increased fiscal revenues and reducing the need to borrow to finance public expenditures.

Additionally, by improving countries' solvency and diversifying their economies, trade openness offers opportunities for more effective public debt management. Studies by Wacziarg and Welch (2008) also highlight that trade openness can help avoid the accumulation of arrears that could undermine the financial credibility of developing countries.

CONCLUSION

This paper examines the impact of exchange rates, inflation, and interest rates on public debt in developing countries, with a particular focus on Morocco. The study employs the System GMM method, which is well-suited to address the endogeneity and simultaneity biases commonly encountered in macroeconomic studies. This econometric approach, developed by Blundell and Bond (1998), is applied to a sample of 47 countries over the period 1990-2022, allowing for the correction of potential biases related to unobserved individual effects and the endogeneity of explanatory variables.

The analysis reveals that, like many other middle-income countries, Morocco often resorts to external borrowing due to insufficient domestic savings, highlighting the importance of studying the impact of monetary variables on its public debt. However, the findings from existing literature on the relationships between these variables and public debt are often divergent and context-dependent, varying according to the specific economic characteristics of each country. This study confirms that the relationships between monetary variables and public debt are complex and context specific.

The results obtained should be interpreted with caution, particularly due to the need for additional robustness tests and the potential inclusion of qualitative variables as well as regional block analyses. To further enhance this analysis, future research will incorporate qualitative variables, such as the quality of institutions and political stability, along with an exploration of regional-specific dynamics. This approach will allow for a more nuanced understanding of the dynamics

in developing countries and the formulation of more targeted and effective economic policy recommendations.

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